Public Disclosure Authorized

Public Disclosure Authorized

Policy, Research, and External Affairs

WORKING PAPERS

Debt and International Finance

WPS 0593

International Economics Department
The World Bank
February 1991
WPS 593

FILE COPY

Risk Management in Sub-Saharan Africa

Stijn Claessens
and
Ying Qian

FILE COPY

The optimal risk-minimizing financial portfolio for Sub-Saharan African countries would include only 30 percent general-obligation loans and 70 percent loans for which repayment obligations are indexed to the price of Sub-Saharan Africa's most important exports: cocoa, coffee, cotton, copper, and oil.

The Policy, Research, and External Affairs Complex distributes PRE Working Papers to disseminate the findings of work in progress and to encourage the exchange of ideas among Bank staff and all others interested in development issues. These papers carry the names of the authors, reflect only their views, and should be used and cited accordingly. The findings, interpretations, and conclusions are the authors' own. They should not be attributed to the World Bank, its Board of Directors, its management, or any of its member countries.

Policy, Research, and External Affairs

WORKING PAPERS

Debt and International Finance

WPS 593

This paper — a product of the Debt and International Finance and International Trade Divisions, International Economics Department — is part of PRE's research on the use by developing countries of financial instruments linked to commodity prices. The paper was prepared for the symposium on African External Finance in the 1990s held at the World Bank in September 1990. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Julie Carroll, room S7-069, extension 33715 (53 pages).

Claessens and Qian investigate the vulnerability of countries in Sub-Saharan Africa to uncertainty about commodity prices, exchange rates, and interest rates.

They discuss some of the instruments these countries can use to manage financial risk and conclude that instruments linked to commodity prices would significantly reduce their risk.

To account for possible interactions between external risks, they estimate the optimal portfolio of financial instruments for Sub-Saharan Africa.

They show that the risk-minimizing portfolio for Sub-Saharan Africa comprises only about 30 percent of general-obligation loans and about 70 percent of loans for which repayment obligations are indexed to the price of Sub-Saharan Africa's most important exports: cocoa, coffee, cotton, copper, and oil.

This portfolio reduces by about 90 percent the uncertainty of Sub-Saharan Africa's resources available for imports.

The risk-reduction benefit of the optimal portfolio is fairly stable for specific commodities included and for the specific period for which it is estimated.

The PRE Working Paper Series disseminates the findings of work under way in the Bank's Policy, Research, and External Affairs Complex. An objective of the series is to get these findings out quickly, even if presentations are less than fully polished. The findings, interpretations, and conclusions in these papers do not necessarily represent official Bank policy.

Produced by PRE Editorial Services

TABLE OF CONTENTS

Prepared for the World Bank symposium, "African External Finance in the 1990s," in September 1990.

The authors are grateful for comments by Brian Pinto, Michael Dooley, Theophilos Priovolos, Bela Balassa and participants in the April seminar.

I. INTRODUCTION

This paper investigates the vulnerability of Sub-Saharan Africa (SSA) countries to commodity price, exchange rate and interest rate uncertainty. It identifies commodity price risk as the most significant external exposure of SSA. SSA countries are particularly vulnerable to commodity price changes given both the large share of primary commodities in total exports as well as the large share of essential foods in their imports. The paper discusses some of the financial risk management instruments available on international financial markets which could be used by SSA and concludes that commodity-price-linked instruments would provide SSA significant risk reduction benefits. Creditors would also gain by introducing commodity-price-linked finance since it reduces their credit risk. Compared with more traditional price stabilization schemes, commodity-price-linked financial instruments can have several other advantages. Most importantly, financial instruments are--by definition--self-financing, result in external risk diversification and are efficient since they do not tie up large amounts of foreign resources (see further Annex I).

To account for the possible interactions between external risks, an optimal portfolio of external financial instruments is estimated for SSA. It is shown that the risk-minimizing portfolio for SSA consists for only about 30 percent of general obligation loans and for about 70 percent of loans whose repayment obligations are indexed to the price of SSA's most important exports: cocoa, coffee, cotton, copper and oil. This portfolio results in a reduction of the uncertainty of SSA's resources available for imports of about

90 percent. The risk reduction benefit of the optimal portfolio is fairly stable with respect to specific commodities included and the specific time period over which the portfolio is estimated.

Many SSA governments have traditionally been involved with domestic commodity price stabilization schemes. However, many of these schemes do not transfer the risk of price movements outside of the economy. As a result, external price shocks are largely absorbed by the government's budget (through the stabilization schemes) and only to a small extent laid off externally. Commodity-price-linked financial instruments could insulate SSA economies from external price movements, but the instruments may require mechanisms internal to the country for allocating the benefits of external price risk reduction among the public sector, parastatals and private sector such that the final producer or consumer receives the benefits. This paper will not discuss how to do this internal risk management, nor any issues related to non-convertibility or capital controls which may prevent the private sector from doing external risk management, but will focus on the SSA economies in aggregate. The issue of internal transfer of external risk management is investigated in a series of cases studies the Bank is currently preparing.

The outline of the paper is as follows. Section II will discuss the major external exposures SSA faces. Section III will discuss issues related to risk identification and risk measurement. Section IV discusses the financial instruments available in developed countries' capital markets to manage external risks. In the next section exposures and financial instruments are matched up by identifying the risk-minimizing external liability portfolio for SSA. Section VI concludes with some policy recommendations.

II. NATURE AND MAGNITUDE OF EXPOSURES

Commodity Exposures

Sub-Saharan countries face large risks because of their relatively undiversified sources of export earnings. Exports of most SSA countries are concentrated in a few primary commodities. Ten key commodities accounted for roughly 75 percent of the region's total exports in 1988.[1] Among 35 African countries for which export data are available for 1984-5, these 10 commodities accounted for more than 80 percent of total exports in 8 countries, more than 60 percent in 19 countries and more than 40 percent in 25 countries. The share of the single largest commodity exceeded 50 percent in 12 countries and exceeded 30 percent in 24 of the 35 countries (see Table 1).

Table 1: Commodity Export Concentration in SSA (1984-5)

Share of Total Exports (Percent)	Numbers of Countries	
	10 Key Commodities	Leading Commodity
>90	3	2
>80	8	5
>70	15	1
>60	19	3
>50	21	1
>40	25	6
>30	28	6

Source: World Bank.

1 These commodities are (with the average share for the period 1965-1980 in parentheses): coffee (9.7), cocoa (6.5), copper (11.1), cotton (3.0), crude oil and petroleum products (36.0), fish, iron ore, tea, timber, and tobacco. Figures are based on exports for relevant 3-digit SITC codes, except for petroleum, which combines crude (331) with refined petroleum products (332), and fish, which combines fresh and simply prepared (031) with tinned (032). In Table 1 in Annex III, the annual shares of the top five commodities are listed for the period 1965-1988.

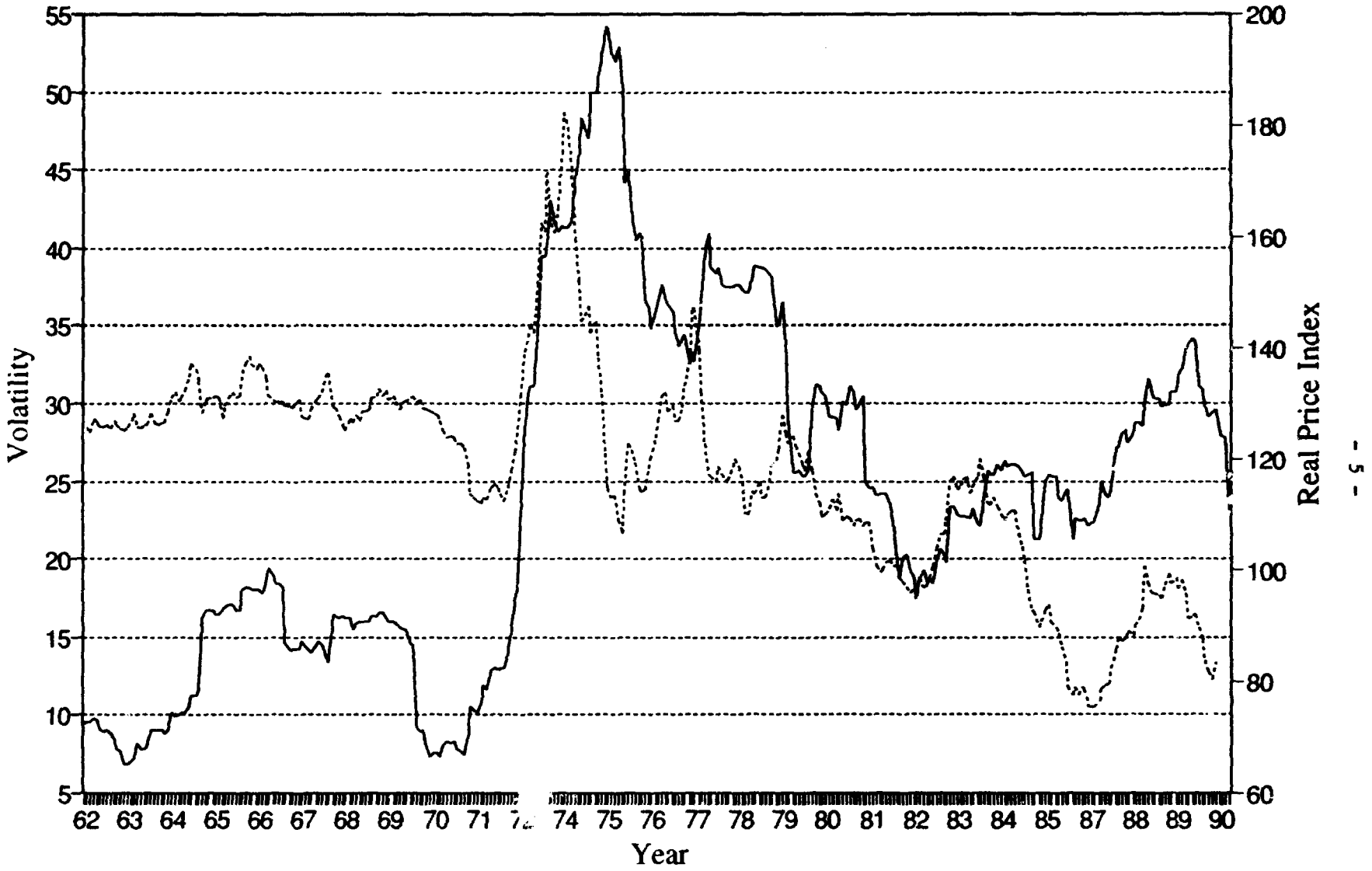
This high degree of commodity dependence continues into the 1990s for most African countries. For some the concentration of exports in the leading commodity increased in the 1980s, as production of secondary commodities fell due to increased competition from other regions, falling prices, and domestically caused disincentives. A few countries, such as Kenya, have diversified the composition of commodity exports, but remain heavily dependent on primary products. Successful efforts to significantly diversify into intermediate and final export products have been limited to exceptional cases, such as Mauritius.[2]

At the same time, world prices for SSA's main exports have been very volatile. During the last decade the annual volatility of an index of nominal prices for 33 primary commodities prices has been more than 20 percent. In Figure 1, the annualized standard deviation of the monthly price changes during the past 24 months is also plotted for the period 1962-1990. As can be observed, this standard deviation has reached levels up to 55% and has in recent years not been below 20%. Some primary commodities have experienced not only large but extremely rapid prices changes. Coffee prices, for example, fell by a third in the last three months of 1987 and again by 45 percent between April and August of 1989. Analysis at the World Bank has shown that of all goods prices primary commodities have historically been one of the most volatile.

---

2 Mauritius used an export processing zone to greatly expand commodity processing and assembly manufacturing operations.

Indices of Volatility & Real Price



Commodity prices also tend to be highly correlated with each other and exporting multiple commodities does not present an effective diversification strategy. Table 2 in Annex III lists the correlation coefficients among the top nine commodities and between these commodities and the Bank's index of 33 primary commodity prices. Most of these correlations are significantly positive and quite high. Table 3 in Annex III lists the correlations of the commodity prices deflated by the import price for SSA. With the exception of crude oil and logs, the real price of commodities are positively related among each other and with the general index. This indicates that, with a few exceptions, exporting multiple commodities is not an effective (real) diversification.

Compounding the impact of volatile prices has been the fact that in the 1980s the trend underlying the volatile prices swings has been downwards. A price index for 33 primary non-oil primary commodities has declined by 33 percent in real terms since 1980, and is now at its lowest level since World War II.[3] Real crude oil prices fell by 60 percent between 1980 and 1989, reaching their lowest level since 1973. Several international price stabilization schemes have collapsed in recent years (tin, coffee and cocoa) and especially beverage commodities have seen a very sharp decline in prices.

While export prices for SSA declined, the prices of imports for SSA countries increased considerably, in part a reflection of a worldwide increase

---

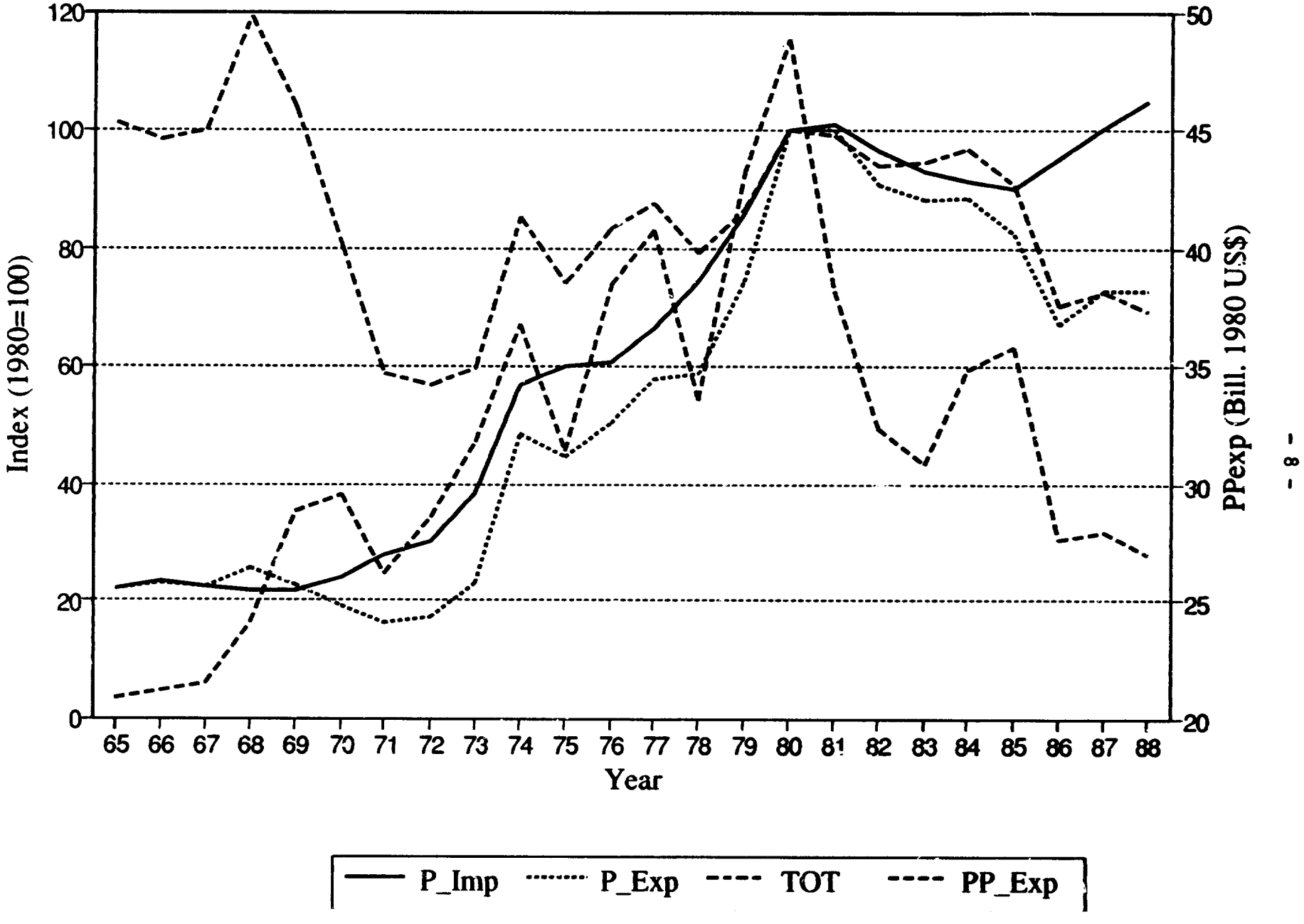
3 Deflating nominal prices by the manufactures unit value of imports of SSA-countries.

in prices, but in part also a results of factors specific to SSA countries (such as the relatively small size of their markets, and their limited access to competitive suppliers; see further Yeats (1990)) which increased their import prices relative to the world average. As a result SSA terms of trade in 1989 were approximately 25 percent below those of 1980, implying a significant income loss. Figure 2 depicts the export price and import price index, the terms of trade for SSA since 1965, and the purchasing power of exports (nominal export values deflated by import prices). A few individual SSA countries were able to post a terms of trade gain during the 1980s, but most SSA countries earned in real terms less foreign exchange from exports in 1989 than in 1980, in spite of export volume increases.

The heavy dependence on primary commodity exports of SSA countries has thus implied that these countries have been faced with considerable uncertainty regarding the real value of their exports and in recent years the reliance on primary commodities as a main source of export revenues has been very unfavorable given the real price decline. It is not likely that SSA will reduce its reliance on primary commodity exports significantly in the near future. In the longer-term, if SSA countries adopt competitive exchange rates and reduce the anti-export bias of their current protectionist policies, other exports can be expected to lead to diversification and reduce the volatility of export earnings (see further Culagovski et al (1990)). At the same time, it is projected that none of the 10 commodities most important among SSA's exports will experience a significant real price increase in the 1990s and some of these ten are even projected to decline significantly in real terms

Figure 2

SSA Exports & Imports Trends



(see World Bank Commodity forecasts).[4] The expectations for import prices for SSA are that they will increase by at least as much as the price index of developed countries' manufactures exports and likely more, leading at most to a small improvement and likely even a further deterioration in terms of trade. In any case, it is likely that primary commodity prices will remain highly volatile in the 1990s and that many SSA countries will continue to be faced with considerable uncertainty in export revenues, in nominal as well as real terms.

Currency and Interest Rate Exposures

In addition to the external exposures of these countries on account of their commodity exports, many of these countries also have external debt structures which expose them to external risks. There are two dimensions here: interest rates and cross-currency exchange rates. The external debt of SSA consists of 33 percent of variable rate debt (either debt which is indexed to a floating rate or short-term debt which is rolled over). This share of variable rate debt is substantially below the share of all developing countries (and that of the highly indebted middle-income countries in particular), something which is due to the large share of concessional and official debt that is fixed rate. However, even though smaller, the share of variable rate debt still exposes the SSA countries to the volatility of international interest rates, which has been high over the last decades.

---

4 Two unchanged (tea and wool), four go down (cotton, tobacco, copper and iron ore), and three go up (crude oil, coffee and cocoa). Real prices are measured in terms of world inflation. To the extent that import price increases for SSA outstrip world wide inflation (as they have done in the 1980s) the trend in real prices will be worse for SSA.

Currency risk arises because the external debt of SSA is denominated in several hard currencies. Approximately 40 percent of SSA medium and long term debt is in US dollars, 14 percent in FF, 8 percent in Yen and 43 percent in other currencies (see Table 3).[5] This implies that the debt service for SSA, measured in any currency, will be affected by movements in the cross-currency rates between these hard currencies. For instance, the depreciation of the dollar between 1985 and 1988 increased the dollar measured debt service of SSA by approximately 7 percent on an annual basis compared to a situation where cross-currency rates had remained at their end-1985 level (see further Table 2).[6] In general, the volatility of nominal (and real) cross-currency exchange rates has been very high during the 1980s (the annual standard deviation of the nominal and real effective US dollar rate has been above 20% in the 1980s) and significantly above levels experienced in earlier periods. The fluctuations in the level of debt stocks and debt service (whether measured in US dollars or any other hard currency) are likely to continue in the future given the fact that the share of non-US dollar currencies in SSA's debt and in SSA's recent new borrowings remains high (see Table 3) and that the volatility of cross-currency exchange rates is not likely to decline in the near future. As Table 3 shows, the currency composition of funds borrowed during the year 1988 is similar to the composition of the existing debt stock, as shown by the division between US dollar liabilities (40.5 versus 39.9

---

5 Allocating the World Bank currency pool over these currencies according to the currency pool composition at end-1989.

6 Measured in non-US dollar currencies (e.g. French francs) the debt stock has decreased since 1985 due to the appreciation of the non-US dollar currencies.

Table 2: Debt Outstanding and Disbursed (DOD), Net Flows and Currency Valuation Effects

YEAR	DOD (Billions)	NET FLOWS (Billions)	CUR VAL (Billions)	CUR VAL (percent)
1982	70.3	10.2	-2.3	-3.3
1983	79.3	7.9	-3.1	-3.9
1984	82.7	5.3	-3.6	-4.4
1985	96.0	2.7	6.2	6.5
1986	112.7	5.9	6.7	5.9
1987	137.7	6.8	10.8	7.8
1988	139.5	4.2	-6.0	-4.3
1989	148.5	4.1	N.A.	N.A.

Note: Valuation effect includes the adjustment on IBRD and other multicurrency loans.

Source: Debtor Reporting System (DRS), The World Bank.

Table 3: Currency Composition of Medium and Long Term External Debt of SSA as of End-1988, and of Disbursements of Medium and Long Term Debt in 1988 (Public and Publicly Guaranteed Debt Only)

	US $	FF	YEN	SwFr	MIX	DM	Oth
MLT DOD	38.3	13.8	4.2	2.5	11.0	7.1	23.1
MLT DOD*	40.5	13.8	7.7	4.5	n.a.	8.9	24.6
DISB	37.8	15.2	3.8	0.2	10.5	3.8	28.7
DISB*	39.9	15.2	7.2	2.1	n.a.	5.5	30.1

Notes: The currency composition of MLT debt does not takes into account the currency composition of IBRD loans (about 1/3 dollar and 2/3 non-US dollars). This is corrected in the line MLT DOD*, and similarly for disbursements in the line DISB*.

Source: DRS, the World Bank

percent) and non-dollar liabilities (59.5 versus 60.1 percent), implying that the dollar value of debt will continue to fluctuate as currencies fluctuate.

The debt service changes, due to interest and currency valuation effects, could have affected the economies of SSA countries adversely if the changes were not matched by commensurate changes in the value of net hard currencies earnings of SSA countries and the resulting capacity to service these debts. Possibly, the movements in debt service due to interest and currency changes were offset by similar movements in SSA's export earnings, implying that the debt service burden did not increase as a result of currency movements. However, this, and its implications for exposure measurement, need to be explored.

Impact of Exposures

The high dependence of SSA on primary commodities exports for foreign exchange earnings, and the interest and currency composition of SSA's external debt portfolio, combined with the high volatilities of these external variables, imply large external exposures for SSA countries. The impact of these external uncertainties and exposures on the SSA economies is threefold. First of all, it results in a highly variable income and consumption stream for the countries, lowering the country's welfare (see Newbery and Stiglitz, 1981). Second, it complicates the government and private sectors' planning and investment processes and (as a result) likely leads to lower (private) investment and a lower long run output level. Third, it makes the economy vulnerable to Dutch (or Nigerian) diseases, where, in times of favorable external prices for the major export products, other export

activities become uncompetitive or unprofitable as a result of the appreciation of the real exchange rate and other distortions introduced as a result of the commodity boom (see Balassa, 1989, and Cuddington, 1989).

The key question this paper will attempt to answer is whether, from an ex-ante point of view, SSA's current external liability structure entails the optimal amount of risk sharing between creditors and debtor countries, or whether a better structure is feasible which allows for gains for both parties. Key is the concept of ex-ante risk sharing. As the experience of the 1980s has shown, ex-post the impact of external shocks on the ability of the countries to service their external debts have been shared between creditors and debtor countries in the form of reschedulings, debt write-offs, internal and external adjustment by the countries. This has resulted in significantly lower growth rates of the countries. This ex-post risk sharing has come with considerable deadweight losses in the form of lost output which could have been avoided through a better ex-ante structuring of the external debt structure of the countries. The next sections of this paper will explore the conceptual issues of external exposure measurement of SSA countries in more depth, look at instruments available for ex-ante external risk management, and propose some practical solutions for a typical SSA country to manage its external risks.

III. CONCEPTUAL ISSUES IN EXPOSURE MEASUREMENT

The previous section clearly established that SSA faces large contractual exposures to commodity price and exchange rates, and to a lesser extent to interest rates movements. The purpose of this section is to investigate, from a theoretical point of view, whether some of these contractual exposures to price changes may be less in real terms due to some offsetting relationships among these and other external variables. The section after this will then on the basis of this analysis calculate exposure measures and determine the optimal liability structure.

Concepts for Measuring Risks

It has been long recognized in the literature that exposures cannot be measured by contractual (accounting) concepts alone. In the economic literature, this was for instance pointed out very thoroughly by Newbery and Stiglitz (1981). One of their insights was that commodity price risks can to a significant extent be offset by quantity risks. In case of a net commodity exporter, if the price elasticity of demand is different from zero, quantity changes will offset the effect of price changes on total earnings. The net exposure of the country to commodity price risks would then be less than the nominal value exported. In the extreme case, when the price elasticity is -1, revenues would be independent of price movements as quantity movements will perfectly offset price movements and there would be no need to hedge against price movements. Figure 2 shows this relationship too: the dollar value of exports for SSA behaves quite different than price index of exports.

In the finance literature, the correct measurement of risk has been part of the mainstream thinking since the Capital Asset Pricing Model (CAPM) was developed in the early 1960s. The main concept of the CAPM is that the risk of holding an individual asset (or, equivalently, an income stream) needs to be defined with respect to a measure of aggregate risk (such as the risks of holding a diversified portfolio of assets). Risks which are diversifiable do not need to be carried and consequently do not receive any higher expected return (risk premium). Only non-diversifiable (systematic) risks require a risk premium.[7] For a country receiving an income stream through its (net) exports, this implies two things: first, risks which arise from commodity price and interest and exchange rate movements need to be defined in an integrated fashion and relative to the country's aggregate economic risks; and second that risks which are in principle diversifiable in the world capital markets (or can be carried in world capital markets at lower costs) need not be carried by the country, and, if they are carried, will not receive a higher rate of return for the country.

Both the economics and finance stream have important implications not only for the measurement of commodity price risks, where quantity movements can be important, but also for the measurement of interest and currency price risks. It implies that changes in debt service resulting from interest and exchange rate movements only represent a change of the burden on the country

---

7 Extensions to the CAPM stressed the fact that the risk of holding assets had to be defined relative to movements in individuals consumption stream as opposed to movements in the market value of these assets alone. For an exporting country this implies that the relative riskiness of an income stream derived from exporting a particular goods needs to be defined with respect to the country's aggregate income streams.

"risk" to the extent that the country's debt service capacity does not move commensurately.

Important for the determination of the SSA's effective ability to generate foreign exchange, which will determine the true burden of changes in exchange rates on debt service, will be the relation between primary commodity prices and the value of the dollar, since on one hand SSA derives such a large share of its capacity to service its debt from primary commodity exports and on the other hand a substantial part of SSA's debt is in non-US dollar currencies. It has long been observed that, in general, commodity prices (measured in dollar terms) tend to move inversely with the value of the dollar: when the dollar increases in value commodity prices tend to decline and vice-versa (see for instance Dornbusch, 1987). This relationship does not appear over shorter periods, but manifests itself in general over long cycles. [8]

The inverse relationship between US dollar exchange and commodity prices is also confirmed for the prices of most of the commodities important to SSA. For instance, over the period 1974-1989, changes in nominal cocoa, coffee, cotton, copper and sugar prices had a negative relationship with changes in the index of the nominal, effective US dollar exchange rate. This

---

8 In the period 1985-87, this relationship seemed interrupted when the dollar declined from its peak after 1985 and commodity prices did not increase. The increased need of many developing countries to expand their exports for debt service may have contributed to keep commodity prices temporarily low. See for instance Gilbert (1989). In the latter part of the 1980s commodity prices recovered and the inverse relationship between the value of the dollar and commodity prices seems to be confirmed. More recently, commodity prices as well as the value of the dollar have declined.

could imply that a combination of primary commodity exports and non-dollar debts may have some benefits since when debt service payments go up due a depreciation of the dollar, primary commodity export revenues measured in dollars are likely to go up too, and vice-versa.

There is an additional aspect important for external risk management: measures such as exports and debt service are nominal and need to be translated into real terms. This can be done through the concept of the purchasing power of exports--the nominal value of exports divided by import prices, which provides a good measuring unit of the real benefits of export. Similarly, nominal debt service payments need to be adjusted for price movements. [9]

The outcome of these interactions between commodity prices, exchange rate, import prices and quantities can be that the effective exposure of the country to commodity prices, interest rates and exchanges rates is in effect different from what contractual and nominal measures--such as exports and debt service due--would indicate. Strategies to manage these risks on the basis of contractual values only could consequently be misleading.

---

9 One way to do this is to compare them to another nominal quantities, such as nominal export. There is another element here however. High nominal debt service payments do not necessarily imply high debt service burdens. For instance, high debt service payments as a result of high international interest rates in a highly inflation environment are less of a burden than low interest payments in a low inflation environment, even if the real interest rate is the same under both scenarios, since in the first scenario interest payments contain a component principal repayment. Effectively the interest payments in the high inflation scenario include repayment of principals and represents less of a real interest burden. This is similar to the concept of operational budget versus primary deficit/surplus in high inflation countries.

Practical Models for Risk Measurement

Several practical models exist that can determine real exposures. Some of these have already been applied to countries with large external exposures, for instance, Turkey, Indonesia, Mexico, Brazil, Costa Rica, Algeria and Papua New Guinea.[10] The empirical results indicated then that there exist some offsetting effects between commodity price, quantity, import price and exchange rate movements. For most of these countries, however, the offsetting effects were small, and as a result, effective exposures coincided to a considerable extent with nominal measures.

In determining the optimal liability structure of a country, two more issues need to be recognized. First of all, external risks should be measured and managed with respect to net liabilities, i.e., external liabilities minus all external assets such as foreign exchange reserves. Secondly, the management of (net) external liabilities has to be done on the basis of a trade-off between the expected effective cost of a particular financial instrument and the uncertainty of its effective cost (where both cost and uncertainty have to be measured in relation to the economy's ability to pay). This turns out to imply that the optimal external liability choice can be split up into two components: a speculative and a hedging component. The speculative components depends, among others, on the expected costs of the

---

10 See Kroner and Claessens (1989) for Indonesia and Turkey, Thompson and Myers (1989) for Costa Rica, Claessens and Coleman (1990) and Coleman and Qian (1990) for Papua New Guinea, and Claessens and Kroner (forthcoming) for Mexico and Brazil. See Claessens (1988) and Claessens (1990) for more general models.

different liabilities. It is reasonable to argue that, even though costs of different types of liabilities will differ, these differences will not be significant enough from the point of view of the country to justify taking speculative positions. For instance, the expected costs of borrowing in different currencies, after adjusting for expected exchange rate changes, will not differ much from each other, since movements in cross-currency exchange rates can be expected to compensate for nominal interest differentials. [11] Similar effects exist for other liabilities. The result of equal expected borrowing costs is that the speculative portfolio disappears, leaving the hedging portfolio. The hedging portfolio is based on risk minimization and the basic rule for liability choice should therefore be **risk minimization** and external exposures should be hedged as much as possible.

---

11 Abstracting from transaction costs, a perfect arbitrage can be made between borrowings in different currencies using the forward exchange (or currency swap) markets. This arbitrage implies covered interest parity: the forward (or swap) rate represents the interest differential between the alternative currencies and the after forward (or swap) nominal cost of borrowings in alternative currencies will be equalized. To the extent that the forward exchange rate represents the equilibrium forecast of the expected future spot rate, the expected effective nominal cost of borrowings in different currencies will be equal and uncovered interest parity will also hold. Ex-ante deviations from uncovered interest parity can be due to factors such as risk premiums and to some extent these deviations can therefore be anticipated. Since ex-ante risks premiums are largely determined in the capital markets of developed countries, which have a comparative advantage in carrying risks, it can be expected that the risk premiums are relatively small compared to the risk reduction benefits for the developing country involved. As long as the developing country is more risk averse than what is implied by the developed countries' capital markets, transferring risks from the developing country to the international capital markets can be an improvement. However, ex-post deviations from interest parity cannot be anticipated and active currency management should therefore be employed to reduce risks through proper diversification. A similar comparative advantage for risk bearing can be established in case of interest rate and commodity price risks.

We will discuss in the next section the possibilities for hedging external exposures with financial and other risk management instruments, with a focus on commodity bonds and on applicability to SSA. In the section after that we will measure the exposures of SSA and the financial risk management techniques SSA countries can use.

IV. HEDGING INSTRUMENTS

As the preceding sections described, SSA's countries have been, and will continue to be, exposed to the risk of instability in revenues and expenses arising from fluctuations in international prices such as currency exchange rates, interest rates, and commodity prices which are beyond the control of each individual SSA country. Financial risk management--the transfers of risk to third parties--could therefore serve a very useful role for SSA and many external financing vehicles available have desirable risk-sharing properties. This section will list those risk management and financing vehicles available which are the most important for SSA.[12]

Many of the financial instruments now available in the international financial markets for managing currency exchange rates, interest rates, and commodity prices have been around for a long time. These include, for instance, forwards and futures contracts on exchange rates and on commodity prices. As a response to both a more volatile international environment and an increase in cross-border transactions and resulting exposures, the use of these financial risk management instruments has increased dramatically over the last decade.[13] In addition, various new risk hedging instruments have been introduced during the last decade, such as currency and interest rate swaps options on foreign exchange in the last decade.

---

12 The instruments which could be used by SSA are described in more detail in the appendix.

13 As can been seen from the increases in the volume of futures contracts outstanding at major exchanges (as reported for instance in Watson et al., 1989).

In recent years a number of new risk management and financing instruments have been introduced which are specifically aimed at entities that have a natural exposure to commodity risks. Such instruments include commodity-price-linked loans, commodity-price-linked bonds, and commodity swaps. These instruments can, in addition to more traditional commodity price risk management instruments (such as commodity futures), manage commodity price risks as well as provide for new financing. They have become available for several commodities.[14]

The financial risk management tools are available to most, well-capitalized firms in developed countries. In principle, these could also be used by developing countries, but so far only a limited number of developing countries have made more than occasional use of these instruments.[15] The limited use of these financial instruments by developing countries is often explained by the low creditstanding of the countries. Some of the instruments involve from the point of view of the provider taking on a certain amount of

---

14 See further Priovolos and Duncan, 1990.

15 See for instance the Quarterly Review of Financial Flows to Developing Countries, March 1990 for an overview of the use of currency, interest rate and commodity price management tools by developing countries.

credit risks and with their low standing credit, these instruments may be as unlikely to be available to SSA countries as private new lending is today.[16]

Of all these financial instruments, the commodity-price-linked instruments are likely to be the most important for SSA for risk management as well as new financing point of view. They can provide the following benefits. First, the commodity-price-linked instruments provide an opportunity for a better management of commodity price risks. With an appropriate design of commodity-price-linked instruments, some SSA countries could substantially reduce the threat of external shocks and separate financial price risks from production risks. Reduced risks can make investment and project planning easier, and thus, make economic development planning steadier and more concrete. Second, the commodity-price-linked schemes can provide better financing opportunities and can provide an access

---

16 As pointed out by the discussant, Micheal Dooley, if commodity prices are non-stationary, creditworthiness may be an especially relevant constraint in case of long term commodity-price-linked instruments. Leaving aside for the moment whether commodity prices are stationary or non-stationary--which is itself subject to a continuing debate, with non-stationary prices either one of the two parties to a hedging contract is likely to end up with a position which will make defaulting on the contract extremely attractive. Consequently, the credit risks on long-term commodity instruments can be extremely large. Many instruments, however, either do not (need to) involve any (or only a limited amount of) credit risk for the counterparty or can be structured in a fashion as to minimize credit risks. Examples where credit risk is eliminated altogether are options (on currency, interest or commodity contracts) bought by the country (which require an up-front premium of the country), or futures (on currency, interest or commodity) bought or sold, which require putting up a margin. In both cases, the legal system in the developed country underwriting the insurance system will ensure that the risk management benefits will be available. Examples where the credit risk is minimized without losing risk management benefits are currency and interest swaps which are marked-to-market on a regular basis and which use a margin account. The use of a margin which needs rebalancing does not mean that the instrument amounts to self-insurance (see further Folkerts-Landau (1989).

to financial markets that would otherwise not have been available. Third, and most importantly in the long run, the improved ability to service debts can lead to an improved creditworthiness of the country in general since a significant component of the creditworthiness risk, the risks of adverse shocks threatening the ability of the country to service its external obligations, is eliminated. This may lead over time to better financing terms (cheaper cost, longer-terms, etc.) on both commodity-price-linked as well as on more conventional types of financing.

In the near future, SSA's independent access to commodity-price-linked instruments will remain limited to short-term hedging instruments, futures and options. Its access to longer-term commodity-price-linked instruments will depend on overcoming creditworthiness constraints, either by marked-to-market mechanisms or by third party credit enhancements.

V. PREFERRED LIABILITY STRUCTURE: MIXTURE OF INSTRUMENTS

The previous two sections identified respectively the concepts involved in measuring the exposure of a country to external risks and the instruments available to hedge these external risks. It is clear that SSA can benefit substantially from altering and improving its liability structure. We will now match up with the external exposures of SSA the hedging instruments available by calculating the optimal liability structure of SSA. We will do this for the SSA countries as a group, realizing of course that individually countries will have different economic structures and therefore different optimal liability structures. The purpose of this section is therefore only to indicate what the benefits could be for SSA as a group of a liability structure with more ex-ante risk sharing.

The derivation of SSA's optimal liability structure, can be done from two perspectives: the economy as a whole and the government's budget alone. The analyses can in addition be done in two ways. one based on historical data and trends; and one based on a sensitivity analysis of expected future flows. This will lead to four possible type of analyses, all based on cashflows derived from export of commodities and other goods and cashflows paid on imports and debt service. We will perform here an empirical analysis only on historical data, but indicate the possible other approaches.

We will use the model by Myers and Thompson (1989).[17] The objective function this model uses (together with the market equilibrium condition that the expected percentage changes in the real prices of commodities are equal to the real interest rate) implies that the optimal liability portfolio will be the hedging portfolio: the portfolio which minimizes the impact SSA faces from external factors.[18] The model requires as inputs total exports earnings, the commodity prices for which financial hedging instruments exist, population numbers and import prices. Since commodity risk is the most important external risk SSA faces, it was decided to include only commodity-price-bonds and general obligation dollar loans in the liability portfolio. Population numbers are used to scale data and import pirces are used to calculate terms of trade for each commodity. To calculate the optimal liability portfolio (a vector of) conditional covariances between prices and exports, and (a matrix of conditional covariances) of prices were estimated as residuals from a vector-autoregressive process (see Annex 2).

The model was run using annual data from 1965 to 1988 for five commodities: coffee, cocoa, copper, cotton and crude oil. Together these five commodities accounted for more than 70 percent of SSA's total exports over the period 1980-1988 (see also Table 1 in Annex III). The model calculated the dollar amount to be borrowed in each of the five different commodity-linked bonds (under different real interest assumptions). The results for the optimal liability portfolios are listed in Table 4. Table 4 is calculated by

---

17 See Appendix II for a short description of the model, the data series used and some further detail on the results.

18 More precisely, the Myers and Thompson model minimizes the variance of the consumption of tradeable goods (imports) in real terms.

taking the ratio of the dollar amount of each commodity-linked bond in the optimal portfolios to SSA's total actual outstanding debt (in dollar terms) in 1988. The amount not borrowed in commodity-linked bonds constitutes general obligation dollar debt. As Table 4 shows, the optimal portfolios in 1988 should have contained a significant proportion of commodity-linked bonds; about 70 percent. The table indicates also that an optimal liability portfolio for SSA would include a large share of copper liabilities in its debt portfolio: about 30%. This share corresponds to an average share of copper exports in total exports over the 1965-88 period of about 11%. The shares for the non-mineral commodities (coffee, cocoa and cotton) may have to be interpreted with caution. SSA exports several products whose price characteristics are closely related to these commodities (tea, and in general prices of agricultural products tend to move closely together). Consequently, the inclusion of these liabilities in the portfolio may reflect the fact that instruments whose servicing obligations are linked to these commodities present also hedging potential against other commodities whose prices are highly correlated.

The outcome of the optimal portfolios depends on the real interest rate assumption made. To check the sensitivity to that assumption, the real interest rate was varied between 1% and 9%. As Table 4 shows that the total proportion of all five commodity bonds in optimal portfolios decreases as the real interest rate goes up. Four out of five commodity bonds have their share decline when the real interest increases. Largely, this can be explained by the fact that higher real interest rate implies higher servicing cost, thus reducing the demand to borrow and lowering the dollar amount of the bonds. Since the denominator (the total amount of debt) is not changed, the

commodity-linked bonds shares decline as real interest go up. [19] This also implies that the hedging effectiveness of commodity bonds is reversely related to the real interest rate assumptions. This becomes clear from Table 5 where the absolute amounts to be borrowed in each commodity bond are listed, expressed in per capita terms. For comparison, the total external debt per capita of SSA in 1988 was $291.50.

Table 4: Optimal Portfolios: Hedging Exports
(As a proportion)

r	Cocoa	Coffee	Cotton	Copper	Oil	Total	General Obligation Debt
1%	17.21	6.69	9.16	41.93	8.46	83.45	16.55
3%	14.22	5.66	14.87	36.23	6.20	77.18	22.82
5%	11.63	4.83	18.93	30.84	4.57	70.81	29.19
7%	9.57	3.94	21.65	25.99	3.39	64.54	35.46
9%	8.15	2.70	23.45	21.61	2.52	58.42	41.58

Source: World Bank estimates.

Table 5: Optimal Portfolios: Hedging Exports
(As an absolute dollar amount per capita)

r	Cocoa	Coffee	Cotton	Copper	Oil	Total
1%	50.16	19.49	26.69	122.24	24.67	243.25
3%	41.45	16.51	43.35	105.60	18.08	224.99
5%	33.91	14.08	55.19	89.91	13.32	206.41
7%	27.91	11.48	63.10	75.75	9.88	188.12
9%	23.75	7.86	68.36	62.99	7.34	170.30

Source: World Bank estimates.

19 Notice that the total external debt is not derived from the model. If the conventional loan in dollar terms is also allowed to decline as the real interest rate raises, changes in relative proportion among commodity bonds and conventional loan will be more complicated.

To illustrate the risk reduction benefits of introducing commodity-price-linked bonds, we can calculate the variance of the relative costs of imports with and without the optimal hedging portfolio. This is done in Table 6. The table shows that the optimal hedge leads to a very significant risk reduction: a reduction in variance of about 90 percent is achieved.

Table 6: Risk Reduction Benefits (Variances)

r	Without Hedging	With Hedging	Risk Reduction	Risk Reduction as a Percentage
1	750.18	52.1	698.07	93.1
2	627.24	57.28	569.95	90.9
5	548.99	60.36	488.63	89.0
7	499.51	61.77	437.74	87.6
9	469.89	62.11	407.78	86.8

Source: World Bank estimates.

The effectiveness of the optimal commodity-bond portfolio as a hedge against relative price (terms of trade) changes depends of course on the availability of the different commodity-price linked hedging instruments. To investigate the effectiveness with respect to this assumption, the optimal portfolios were reestimated with only a set of four instead of five commodity-price linked bonds. These calculations indicate that the cocoa and cotton price linked bonds are the most effective hedging instruments: without these bonds the risk reduction of the optimal portfolio drops to about 65 percent. Surprisingly, the total dollar amount to be borrowed in commodity bonds actually increases when cocoa is dropped, because the dollar amount of the copper bond increases. When cotton is dropped the total dollar amount borrowed in commodity bonds drops as expected. The other three commodities appear to

be less effective hedges since the risk reduction of the portfolio remains about the same (90 percent) when anyone of these three is dropped from the portfolio.

A possible problem with estimating the optimal liability portfolios can be stability: estimates of optimal portfolio shares can change from period to period. This can reduce the effectiveness of the portfolio strategy since ex-post the chosen portfolio may not be the optimal one and since it can require (large) costly portfolio rebalancing each period when shares (or amounts) change. To check for the stability of our results we calculated the optimal portfolio shares for a different sub-period, 1965 to 1982. Further sensitivity could be performed by rolling this period forward, e.g. 1965-1984, 1965-1984, etc, up to 1965-1988. The results are reported in Table 7 for a real interest rate of 5 percent (similar results were obtained for other interest rates). As one can observe, the dollar amounts to be borrowed in the coffee and cotton commodity bonds for the period 1965-1982 are very similar to those for the period 1965-1988 (the numbers are all 1980 real dollars). The big changes are for the copper and oil bonds, and to a lesser extent for the cocoa bonds. This is largely due to differences in expected future prices: for example, the real oil price expected for the next year is almost twice as high in 1982 than in 1988. Changes in expected prices influence the composition of the optimal portfolio and, since those changes were the largest for oil, copper and cocoa, the borrowings in these bonds were most affected.

The percentage to be borrowed in the form of general obligation debt was the same for both periods, about 30 percent. The shorter estimation period reduced of course the fit of the autoregressive model for the commodity prices

and affected therefore the effectiveness of the portfolio as a hedge. However, the relative risk reduction was still very high and similar to that of the longer estimation period (85 percent). This indicates that a portfolio of commodity bonds can achieve a significant degree of risk reduction, however the rebalancing of the portfolio from year to year may make it too costly to aim for the highest degree of risk reduction. There will exist a tradeoff between the degree of risk reduction and the degree of rebalancing each period: the cost of rebalancing and the stability of the portfolio will therefore determine an optimal "average" portfolio.

Table 7: Optimal Portfolios: Hedging Exports
(As an absolute dollar amount, first line
and as a proportion, second line)

r	Cocoa	Coffee	Cotton	Copper	Oil	Total	General Obligation Debt
1965-1982							
$ Amnt	9.66	17.95	44.71	11.37	54.69	138.35	55.25
Percent	5.00	9.26	23.09	5.87	28.26	71.46	28.54
1965-1988							
$ Amnt	33.91	14.08	55.19	89.91	13.32	206.41	85.09
Percent	11.63	4.83	18.93	30.84	4.57	70.81	29.19

Source: World Bank estimates.

Economy Versus Government Exposures

The exposure of the economy to international price changes will be different from the exposure of the government budget to international prices when movements in export earnings are not one-to-one translated into changes in government revenues. For instance, many of the taxes governments in SSA countries collect (direct and indirect) do not depend proportionally on

commodity prices but are likely progressive. Taxes on corporate income from export companies are likely progressive with respect to commodity prices. Earnings of state enterprises will neither depend in a proportional manner on prices. On the other hand, the impact of price fluctuations on government revenues may be somewhat mitigated through the use of stabilization schemes already in place, as long as these are stabilization schemes which involve the use of external liabilities or assets.[20]

Consequently, the budgets of SSA goverments may be exposed differently than their economies to international price movements. No attempts were made here to estimate the optimal portfolios for hedging the government budget--given the incompatibility of different definitions of government revenues and expenditures. However, the difference in exposure of government versus the economy should be kept in mind when interpreting the results and when designing for individual country applications.[21]

Future Exposure

Future exposures to international prices will differ from historic and current exposures when composition and level of exports or imports will change. For an analysis of the future exposure of an individual SSA country

---

20 Stabilization schemes for domestic purposes (e.g., for farmers) which involve the accumulation or depletion of domestic assets (e.g. government bonds) do not insulate the economy in any way from external risks. Such instruments can be used to reallocate risks within the economy, but leave the total risks of the economy unchanged.

21 Important in this respect will be whether most of the external liabilities are public or publicly guaranteed and whether the private sector has access to external risk management techniques.

to international price movements, sensitivity analyses could be performed on projections for balance of payments and government finances. Deviations in forecasts for balance-of payments and government budget from a baseline for alternative commodity or goods prices and interest and exchange rates (compared to base case prices) can then indicate the sensitivity of the economy and budget to different external shocks and the resulting optimal portfolios.

VI. IMPLICATIONS AND CONCLUSIONS

The matching up of the external exposures of SSA with the different type of external liability instruments available indicates that SSA could improve its liability structure significantly. The paper shows that SSA could achieve a significant reduction in the uncertainty concerning the resources available for imports after debt service, especially by using commodity-price linked instruments. Sovereign risk factors will impose constraints on the type of instruments and the amount of risk sharing feasible between SSA and its creditors. However, sovereign risks do not rule out the use of all financial risk management instruments and there are means to make these instruments available to SSA, such as collateral and marked-to-market mechanisms. The extensive use of long-dated currency and interest rate, and more recently commodity price, risk management tools by firms in developed countries of all kind of credit standing seems to indicate that credit risks can be overcome.

Most importantly, there is scope for the intervention of international official institutions and governments of developed countries to encourage use of these instruments. This can take different forms, varying from: providing technical assistance regarding the use of hedging instruments (education, training, design of strategies); direct intermediation of and providing guarantees for financial instruments with important risk sharing characteristics (especially commodity-price-linked instruments for SSA); facilitating technical problems associated with marked-to-market (commodity) swaps; providing the right regulatory and accounting framework for these instruments in developed countries; and encouraging structural changes in the

developing countries which will better allow for the use of such instruments. An important opportunity in this respect can be the restructuring of the external debt of many of these developing countries. This provides room for changes in contractual terms and changes in ownership of claims which could include more risksharing. However, since there exist a free-rider problem introducing more risk-sharing by one creditor generates an externality which benefits all creditors--public intervention may be necessary. Other opportunities may present themselves in the privatization of state enterprices involved with commodity production or consumption.

ANNEX I: RISK MANAGEMENT TECHNIQUES *

There are, generally, three forms of risk management: (a) self-insurance; (b) financial market instruments; and (c) other instruments. The first category includes stabilization schemes, export diversification, and reserve management schemes. The second category includes financial market instruments such as futures, forward, options, swaps, and commodity-linked financing, etc. The third category includes all other schemes such as international commodity agreements and compensatory financing schemes (e.g. Stabex of the EEC and CCFF of the IMF).

A. Self-Insurance and Other Schemes

Self-Insurance Schemes

While several forms of self-insurance schemes exist, they can largely be classified in three groups: (a) national buffer-stock or buffer-fund schemes, (b) export diversification, and (c) reserve management. Each one of these have at times been used by one or more SSA countries. The following are description of the schemes in each group and their characteristics.

National buffer-stock or buffer-fund schemes have been used in many developing countries to smooth swings in export revenues of a certain commodity (or commodities), wherein either schemes some quantity of a commodity (or commodities) or money in a "surplus" year is stored and carried over to the following years. Buffer-stock schemes are more common among countries which are large producers of a certain commodity and can influence (or believe they can influence) its price by controlling the supply of the commodity to the markets. The costs of storing a large quantity of commodities are usually high, and how much and when to carry over and to release stock of commodities is not easy to determine. Buffer-fund schemes are more common among countries which are not in a position to influence prices of their export commodities. Buffer-fund schemes generally aim at not only compensating a shortfall in commodity revenues but also at preventing temporary increases in revenues from resulting in an unsustainable expansion of a country's expenditure level.

Buffer-fund schemes stabilizing revenues from a single agricultural product (e.g. copra) have been established in some countries in the South Pacific. A few countries, such as Vanuatu and Solomon Islands have had some success in using a self-financing buffer-fund, while others (Fiji, Tonga, and Western Samoa) have had reportedly less success.[22]

Export diversification, as is well-known in the South-East Asian region, is usually viewed as diversification of export industries from (primary) commodity exports into manufactures. The idea underlying export

---

* This Annex was written by Toshiya Masuoka. See further Masuoka (1990).

22 Brian Hardaker and Evan Fleming, "Policy Issues in Agricultural Market Development in the South Pacific Region," 1986.

diversification is that fluctuations in export revenues of individual products, resulting from short-run exogenous changes in demand and supply conditions, can be offset by producing and exporting a variety of products. Although this strategy seems to have a number of supportive cases where diversification has contributed to reduced export earning instability, it is unlikely a measure immediately applicable to a group of countries like SSA, since the diversification process requires a long time, a substantial amount of investment, and may not be SSA's comparative advantage. While an export diversification strategy is being pursued, other risk management activities should be carried out at the same time.

The last approach of self-insurance, reserve management, involves improvements in the matching of foreign asset with liabilities. This type of scheme usually takes the form of holding sufficient and appropriate foreign exchange reserves and/or selecting appropriate maturity composition of external debts. Many developing countries have had difficulties in servicing their debts largely caused by mismatches in their asset/liability structures. To prevent these problems from happening again, foreign exchange reserves could be held as a buffer against temporary shortfalls in exports earnings.

Other Schemes

Other schemes in this context include international commodity agreements and compensatory financing schemes such as Stabex of the European Economic Community (EEC) and Compensatory and Contingency Financing Facility (CCFF) of the IMF. Several of these schemes have been used by SSA countries. The commodity agreements are basically multilateral buffer-stock schemes. The idea is that efforts to reduce short-term fluctuations in the commodity exports can be more effective, when done in the form of a multilateral scheme. Until recently, there were five major international commodity agreements currently in operation: the International Sugar Agreement, the International Natural Rubber Agreement, the Sixth International Tin Agreement, the International Cocoa Agreement, and the International Coffee Agreement.

However, the effectiveness of commodity agreements to insulate commodity price variability is questionable. As is exemplified in recent developments of the coffee and cocoa agreements, these inter- national agreements may not be able to stabilize prices in the long term and may be prone to dispute among participants who have varying interests.

The EEC provides a compensatory financing facility, Stabex, for their trade partners. Many SSA countries are major users of Stabex. Stabex is a partial compensatory scheme for the loss of country's export earnings. It can only be used for a shortfall in the export earnings of agricultural commodities (48 items) to the EEC. The user of Stabex should be aware that maintaining a position as a major user of Stabex means staying largely dependent on agricultural commodity exports to the EEC. The merits of the Stabex to a country are its quick disbursing nature (within two years of the shortfall on average) and its "cheapness" (mainly grants).

The IMF provides a compensatory financing facility (CCFF) which has characteristics similar to Stabex, but covers a small area than the CCFF covers. The CCFF covers total export earnings and cost of cereal imports. The CCFF requires, however, stricter repayment conditions: a borrower in the CCFF has to repay within 3-5 year period, irrespective of its balance-of-payments position.

B. Financial Market Instruments

Financial Market Instruments

Significant innovations and improvements in terms of risk management techniques have taken place in the international financial markets in last decades. International financial markets have responded to the increased need to manage currency exchange rate, interest rate, and commodity price uncertainty by introducing various types of financial instruments. These risk-management instruments include: forward, futures, options, and swaps. In addition, commodity-linked financing instruments, which combine risk management and finance, have recently been added to the field of commodity price risk management.

Here we describe forward, futures, options, and swaps and explain their characteristics. The section looks closer at commodity risk management instruments, especially, commodity swaps and commodity-price-linked financing schemes.

Forward, Futures, Options, and Swaps

a) Forwards. A forward contract obliges its buyer to purchase a given asset on a specified date at a price specified on the date of contracting a forward. At maturity, if the actual price (spot price) is higher than the contracted price, the forward buyer makes a profit. If the price is lower, the buyer suffers a loss. The seller of a forward contract is obligated to deliver a given asset to a buyer (or settle in cash) at a pre-specified price. His/her payoff is just the opposite of the buyer of the forward contract.

Forward contracts are often used for hedging the risk of holding a certain asset or a liability. By using a forward, the owner fixes his/her revenues from the future sale of the asset at the time he/she contracts a forward. Two important characteristics of forward contracts are that they involve no transfer of cash is at the time of contracting a forward, and that involve credit risks since it is uncertain whether each of the two sides will (be able to) deliver their part of the contract.

Liquid forward markets are available for major currencies. There is virtually no difficulty in transacting a forward up to 1 year maturity. For periods beyond one year, forward markets are less liquid. However, currency swaps can serve the role of forwards. Forward markets for major currencies have no formal exchanges.

Forward contracts for international interest rates are known as forward rate agreements (FRAs). Like currency forwards, markets for FRAs are

liquid up to 1 year, and beyond that, interest rate swaps play a major role in interest rate risk hedging. The mechanisms of FRAs are similar to currency forward contracts': two parties agree upon paying or receiving a pre-specified interest rate on a certain amount of money at a certain future date for a future period.

Forward markets for commodities are less liquid than those of currencies and interest rates. The London Metal Exchange is one of the largest forward markets for commodities: aluminum, copper, lead, nickel, and zinc are liquidly traded.

b) Futures. The basic concept of futures contracts is similar to that of forward contracts: the buyer of a futures contract is obligated to purchase a specified asset at a specified price on a specified date. However, forward contracts and futures contracts differ significantly in the following 4 points. First, contract terms (amounts, grades, delivery dates, etc.) are all standardized in futures contracts. Second, transactions are made only on organized exchanges through clearing house systems. Third, profits/losses in trades are daily settled.[23] Fourth, one who trades a futures contract is required to put a small amount of "margin" money in the exchange as a sort of collateral. Through these arrangements, futures contracts significantly reduce the credit or default risk entailed in forward transactions. Liquidity of the markets has also improved because of the standardization of contracts.

The same type of hedging activity can be done with futures contracts as with forward contracts. The major differences from forward contracts are the following three. First, gains and losses on futures contracts are settled daily. This requires transfers of some cash to and from the exchange almost every day. Second, the exporter has to deposit some margin money in the exchange at the beginning of a futures transaction. Third, the exporter can virtually ignore credit risks, since the exchange guarantees performance through the aforementioned systems.

Futures contracts are available for major currencies, interest rates, and commodities. For commodities, very liquidly traded contracts are metals such as gold, silver, and copper, and commodities such as crude oil. Numerous contracts are also available for most primary agricultural commodities.

c) Options. An option is the right to buy or sell a certain asset at a specified price on (or before) a specified date. A buyer of the option owns the right to buy or sell and a seller (or "writer") of the option gives the right to buy or sell to a buyer. A number of technical terms are involved in options transactions:

---

23 A futures contract is "marked to market" every day, using the closing price of the day ("settlement price"). Profit/loss of a trader of futures contracts are calculated by using the settlement price, and their profit/loss are settled with clearing houses daily. This prohibits one from carrying over a huge unrealized loss over a long period, and thus, reduces the risk of default.

(a) If the option gives the right to buy, the option is a "call" option: if it gives the right to sell, it is a "put" option;

(b) The asset on which the option is written is referred to as the "underlying" asset;

(c) The price at which a buyer of the option can buy or sell the underlying asset is called the "strike" or "exercise" price;

(d) If the right to buy or sell is exercised by the buyer, the option is "exercised;"

(e) The date on (or before) which the buyer can buy or sell the underlying asset is called the "maturity" or "expiration;"

(f) An option which can be exercised only on the expiration date is called a "European" option; an option which is exercisable on or before the expiration date is an "American" option;

(g) The price of the option is called a "premium." The buyer pays the premium to the seller at the time of contracting.

Options can also be used as hedge instruments. Compared to forward and futures contracts, options have the following three interesting characteristics. First, unlike forward or futures contracts in which the future price is "locked-in," options contracts limit the maximum loss (equal to the premium paid up-front), but leave an opportunity to take an advantage of favorable price movements. Second, the buyer has to pay the premium up-front. This often requires a significant amount of cash at the purchase of options. Third, while the buyer of options faces credit risk or default risk of the counterparty, the seller does not. It is the seller who is liable, not the buyer.

There are liquid markets for options on currencies with short-term maturities. These options are traded both in the informal manners as forwards and in formal exchanges as futures. Long-term options on currencies are not traded actively. Interest rate options have also liquid markets. There are two forms: options on interest rate bearing securities (e.g. options on U.S. Treasury bonds) and options on interest rates themselves. The latter are known as "caps" and "floors," which are, in effect, a series of options maturing on different dates. Caps are call options and floors are put options on interest rates.

For commodities, options on physical commodities and options on commodity futures are available for short-term maturities. Among them, the most actively traded contracts are on gold, silver, and oil. Long-term options are traded primarily on gold, silver, and oil; however, the markets are not very active.

d) Swaps. A swap contract obligates two parties to exchange, or swap, specified cash flows at specified intervals. This means that a swap contract can be viewed as a series of forward contracts. For example, one party delivers a pre-specified amount of a currency in exchange for another

currency on every date specified in the currency swap. Swaps contracts, therefore, have the same characteristics as forward contracts: no cash flows are involved at the beginning[24] and credit risks are involved. However, swap contracts have the important feature that they are available for longer (3-10 years) maturities. In interest rate swaps, two parties generally exchange floating interests and fixed interest payments. Markets for both currency and interest rate swaps have good liquidity and maturities can generally be extended up to 10 years. Transactions are made through informal linkages of traders and brokers by phone and telex. Also, swaps are often accompanied with bond issues in the Euro-markets.

Commodity swap contracts are the most recent development in the swap markets. The idea is the same as in currency swaps and interest rate swaps: two parties promise to exchange floating prices and fixed prices on a certain commodity. Markets for commodity swaps are not yet active, but have been growing. The swaps are available primarily for gold, silver, and crude oil. They are also available for copper, aluminum, nickel, zinc, and jet fuel to a lesser degree. Commodity swaps are but one of a larger set of commodity-price-linked financing, which can provide SSA with better management of commodity price risks and a new way of external financing. Given the large commodity exposure SSA faces, we will explain commodity swaps and other commodity-linked loans and commodity bonds in more detail.

Commodity Swaps

The basic idea of a commodity swap is the same as those of a currency and interest rate swap. A commodity swap does not involve deliveries of physical commodities. Commodity swap transactions are pure financial transactions. The following example may make this point clear.

Assume that an oil producer wants to "lock-in" the price of his oil exports for the next five years, and that he is able to export 1 million barrels a year. He arranges with a commercial bank the following commodity swap agreement.

---

24 Some designs of currency swaps involve exchanges of cash at the beginning and/or at the end of the contract life to accommodate specific needs of users. However, this does not alter the essential nature of swaps mentioned in the text, since these designs can be regarded as a combination of a plain swap and cash flow transactions at the beginning and/or at the end.

Commodity:	Oil
Amount:	The U.S.dollar equivalent of 1 million barrels of oil every year.
Fixed Price Payor:	Commercial bank.
Floating Price Payor:	Oil producer.
Tenor:	5 years, with annual payments.
Fixed Price:	US$ 25.00 per barrel.
Floating Price:	The average daily closing spot price of North Sea Brent oil over the year preceding each payment date.
Settlement:	Netting-out[25]

In this example, the oil producer sells oil to the third party from time to time at the spot price. However, his revenues for the next 5 years are effectively fixed with the use of the oil swap at a price of oil of U.S.$ 25.00.

One important point should be noted on this example. The oil producer has reduced the probability of default of his business by the use of the oil swap. Even if the price of oil declines to, say, U.S. $ 18.00, his revenues stay the same. This improved credit risk may lower the cost of financing his working capital or may give him an access to new lenders. This point will be clear in the next case: commodity-linked loans.

Commodity-Linked Loans

Commodity-linked loans are loans in which interest and/or repayment amount are linked to the price of a certain commodity or to an index of price(s) of commodity (commodities). Interest as well as principal payments can be linked to the cash equivalent of a certain quantity of a commodity, or only interest payments can be linked to a commodity price. In effect, a commodity-linked loan is a loan which combines a conventional bank loan with a

25 "Netting-out" means that settlement is calculated by multiplying the contracted amount with the difference between the fixed and floating prices. The floating price payor pays the calculated amount, if the floating price is higher than the fixed price, and vice versa.

commodity swap and a commodity-linked loan or a conventional bank loan combined with a commodity swap yield the same financial result.

Commodity Bonds

Most commodity bonds (or commodity-linked bonds) are of two types: a forward type and an option type. In the first type, principal and/or coupon payments are linked to the price of a certain commodity or to an index of price(s) of commodity (commodities). If only the principal payment (redemption value) is linked to a commodity price, the bond in effect combines a conventional bond and a commodity forward contract. If the coupon payments are also linked to a commodity price, the bond is in effect a combination of a conventional bond and a commodity swap. Forward type bonds are often issued by commodity producers for the risk hedging purpose. Option type bond combine a conventional bond with commodity options. In this case, a holder of the bond owns in addition to a conventional bond the right to buy or sell a certain commodity at a certain exercise price. Option type bonds are often used to lower the cost interest rate on the bonds in exchange for attaching long-term commodity options.

Let us consider a hypothetical example of a SSA country which exports gold and which issues a forward-type bond linked to the gold price in the euro-bond market to raise U.S.$ 50 million. Suppose the current price of gold is U.S.$ 400 per troy ounce. The gold bonds could be the following:

Issuer:	SSA government.
Face Value of a Bond:	U.S.$ 1,000; 50,000 bonds
Amount:	U.S.$ 50 million (U.S.$1,000 x 50,000 bonds).
Issue Price:	U.S.$ 1,000 per bond.
Maturity:	10 years
Coupon Payment:	Annual payments of the dollar equivalent of 0.25 troy ounce of gold (multiplied by the reference price) per bond.
Reference Price:	The average daily London morning fixing price of gold over the last year preceding each coupon payment date.
Redemption:	The dollar equivalent of 2.5 troy ounces of gold (multiplied by the reference price.).

In total the 50,000 gold bonds, each of which has a U.S.$ 1,000 face value, can raise U.S.$ 50 million. The amounts of gold necessary for the annual coupon payment and the redemption are 12,500 troy ounces (0.25 troy oz. x 50,000) and 125,000 troy ounces (2.5 troy oz. x 50,000), respectively. Based on the current gold price of U.S.$ 400 per troy ounce, the coupon rate of the bond is 10% (U.S.$ 400 x 0.25 troy oz. = U.S.$ 100, which is 10% of the face value.)[26] In this example, the SSA country can service the debt from part of export revenues of gold, regardless of the gold price over 10 years. The quantity of annual gold exports which is necessary to repay this debt is 12,500 troy ounces, or approximately 390 kg. The gold necessary for the redemption is approximately 3.9 tons.

Most commodity bonds issued so far have been linked to gold and oil. Some are issued on silver, copper, and nickel, and others are issued on softer commodities such as coffee and cocoa.

---

26 The true yield to maturity on this bond should be calculated by using the forward rates of the gold. Numerous variations of these bonds can be conceivable by using gold option features. However, we limit the example to the basics here.

Annex II: Analytical Model[27]

In a small open economy, assume all external debt is issued by a single agent. Debt can be issued as a conventional loan or as any kind of a commodity-price-linked bond. The agent has a utility function:

$$u_t(m_t) = \bar{m}m_t - \frac{1}{2}m_t^2 \qquad (1)$$

where m_t is the real value of import, and $\bar{m}$ is the bliss level of import.
The agent faces a budget constraint:

$$m_t + rd_{t-1} + p_t'b_{t-1} \leq x_t + (d_t - d_{t-1}) + w_t'b_t \qquad (2)$$

where d_t is the conventional loan at time t. $b_t = (b_{1t}, b_{2t}, \ldots, b_{Mt})'$,[28] is the vector for quantity of commodity bonds which is directly associated with the physical unit of the commodity. $w_t = (w_{1t}, w_{2t}, \ldots, w_{Mt})'$ is the vector of prices of the commodity bonds. $p_t = (p_{1t}, p_{2t}, \ldots, p_{Mt})'$ is the vector of prices of the underlining commodities. x_t is the real value of exports. r is the real interest rate. rd_{t-1} is the debt service on the conventional loan; $p_t'b_{t-1}$ is the debt service on the commodity bond; p_{t+1} and x_{t+1} are stochastic.
The agent also faces transversality conditions (or solvency conditions):

$$\lim_{t\to\infty}(1+r)^{-t}d_t = \lim_{t\to\infty}(1+r)^{-t}w_t'b_t = 0 \qquad (3)$$

The agent's problem is to choose a portfolio of commodity-linked bonds and conventional debt to maximize the expected life-time utility function:

$$E_0\sum_{t=0}^{\infty}\beta^t u(m_t) \qquad (4)$$

subject to (2) and (3).
The associated Euler equations are:

---

27 See Myers and Thompson, 1989.

28 All vectors are denoted as column vectors.

$$u'(m_t) - \beta(1+r) E_t u'(m_{t+1}) = 0 \tag{5}$$

$$u'(m_t) w_t - \beta E_t (u'(m_{t+1}) p_{t+1}) = 0 \tag{6}$$

The optimal import path can be defined following the permanent income hypothesis of consumption:

$$m_t = \frac{r}{1+r} [\sum_{i=0}^{\infty} (1+r)^{-i} E_t(x_{t+i}) - p_t' b_{t-1} - (1+r) d_{t-1}] \tag{7}$$

Define $y_t = (x_t, p_t', s_t)'$, where s_t is a set of other state variables, and assume y_t follows the autoregressive process:

$$A(L) y_t = \epsilon_t \tag{8}$$

where A(L) is a matrix polynomial in the lag operator and ϵ_t is a zero mean serially uncorrelated error vector with covariance matrix Ω. Given (7), the optimal projection of future income stream derived from exports can be defined as:[29]

$$\begin{gathered} \sum_{i=0}^{\infty} (1+r)^{-i} E_t(x_{t+i}) = \gamma' y_t + B(L) y_{t-1} \\ \gamma' = \phi A(\frac{1}{1+r})^{-1} \\ B(L) = \phi A(\frac{1}{1+r})^{-1} [\sum_{j=1}^{q-1} [\sum_{k=j+1}^{q} (1+r)^{j-k} A_k] L^{j-1}] \end{gathered} \tag{9}$$

where ϕ is a row vector with a one in the first column and zeros elsewhere. Substituting (9) into (7) gives the operational decision rule:

$$m_t = \frac{r}{1+r} [\gamma' y_t + B(L) y_{t-1} - p_t' b_{t-1} - (1+r) d_{t-1}] \tag{10}$$

Rearranging the Euler equations (5) and (6) gives:

$$E_t [u'(m_{t+1}) (w_t - \frac{p_{t+1}}{1+r})] = 0 \tag{11}$$

---

29 See Hansan and Sargent, 1980.

Assume that the expected real rate of return on holding commodity bonds is equal to the real interest rate on the conventional loan:

$$E_t(w_t - \frac{p_{t+1}}{1+r}) = 0 \tag{12}$$

Then, by (11) and (12):

$$E_t(u'(m_{t+1}))\,E_t(p_{t+1}) = E_t(u'(m_{t+1})\,p_{t+1}) \tag{13}$$

Which implies that the conditional covariance between marginal utility and prices = 0:

$$COV(u'(m_{t+1}), p_{t+1}) = 0 \tag{14}$$

From (1), the first derivative of $u_{t+1}(m_{t+1})$ with respect to m_{t+1} is:

$$u'(m_{t+1}) = \bar{m} - m_{t+1} \tag{15}$$

So (14) is equivalent to:

$$COV(m_{t+1}, p_{t+1}) = 0 \tag{16}$$

Leading (10) one period and computing the relevant covariance as (16) leads to:

$$COV(\,(\frac{r}{1+r}(\gamma' y_{t+1} + B(L)\,y_t - p'_{t+1}b_t - (1+r)\,d_t)\,), p_{t+1}) = 0 \tag{17}$$

Rearranging (17)[30] and recognizing the fact that all variables at time t are known and thus drop out of the covariance expression, leads to:

$$\Omega_{py}\gamma - \Omega_{pp}b_t = 0 \tag{18}$$

where Ω_{py} is the covariance operation between vector p and y; Ω_{pp} is the covariance matrix of vector p.

Solving for b gives:

$$b_t = \Omega_{pp}^{-1}\Omega_{py}\gamma \tag{19}$$

---

30 For simplicity, subscript t+1 has been dropped.

While the optimal portfolios have been computed, it is important to determine whether the variance of real import is reduced in order to evaluate the hedging effectiveness of commodity-linked bonds and regular debt.

Leading (10) one period, the conditional variance of m_{t+1} at time t giving that the optimal portfolio is chosen, is equal to:

$$\begin{aligned} VAR(m_{t+1}) = &\left(\frac{r}{1+r}\right)^2 (VAR(\gamma' y_{t+1})^2 + VAR(p'_{t+1} b_t)^2 \\ &-2COV(\gamma' y_{t+1} p'_{t+1} b_t)) \\ &-\left(\frac{r}{1+r}\right)^2 (\gamma' \Omega_{yy} \gamma + b_t' \Omega_{pp} b_t - 2 b_t' \Omega_{py} \gamma) \end{aligned} \tag{20}$$

Rearrange (18):

$$\begin{aligned} &\Omega_{py}\gamma - \Omega_{pp} b_t \\ &b_t' \Omega_{py} \gamma - b_t' \Omega_{pp} b_t \end{aligned} \tag{21}$$

Substituting (21) into (20):

$$\begin{aligned} VAR(m_{t+1}) = &-\left(\frac{r}{1+r}\right)^2 (\gamma' \Omega_{yy} \gamma + b_t' \Omega_{pp} b_t - 2 b_t' \Omega_{py} \gamma) \\ &-\left(\frac{r}{1+r}\right)^2 (\gamma' \Omega_{yy} \gamma - b_t' \Omega_{pp} b_t) \end{aligned} \tag{22}$$

It is apparent to see that two items in (22) are in the quadratic forms and that they are, by definition, non-negative. If there is no external financing available, i.e., b is zero, then the variance of m_{t+1} is simply the first item in the expression. If there are some external financing, i.e., some elements in b are non-zero and the second item in (28) is always positive. Thus the conditional variance of m_{t+1} is always smaller than the unconditional variance of the exports earnings alone.

Table 1: Share of Top Five Commodities in SSA's Total Exports

Year	Share of Top 5	Cocoa	Coffee	Cotton	Copper	Crude Oil
1965	44.94	7.15	12.15	4.03	16.29	5.32
1966	50.34	6.55	12.65	4.30	20.96	5.88
1967	52.55	8.28	12.01	5.06	21.47	5.72
1968	52.81	8.64	12.94	5.17	24.00	2.07
1969	55.55	9.44	9.84	4.50	25.14	6.63
1970	59.98	8.38	11.59	4.52	23.62	11.86
1971	59.02	7.32	11.26	4.29	14.90	21.25
1972	58.78	5.98	10.03	3.85	14.24	24.68
1973	60.92	6.01	9.48	3.41	15.68	26.35
1974	73.10	4.92	6.44	2.33	12.85	46.56
1975	69.20	5.82	6.79	2.16	7.58	46.84
1976	69.22	5.12	10.02	2.65	7.03	44.40
1977	74.28	7.62	14.40	2.58	6.13	43.55
1978	72.00	10.96	12.89	2.19	5.96	39.99
1979	70.80	6.51	8.58	1.97	5.62	48.12
1980	75.81	4.41	6.60	1.52	5.15	58.13
1981	77.62	4.53	5.93	1.69	4.99	60.49
1982	86.72	4.80	8.02	1.54	5.12	67.24
1983	81.58	4.68	8.51	2.33	5.59	60.48
1984	81.46	5.23	8.11	2.67	4.63	60.81
1985	85.73	6.09	7.54	2.06	4.55	65.48
1986	71.82	7.51	13.60	2.60	5.42	42.69
1987	65.51	6.84	8.47	2.81	5.60	41.80
1988	40.71	3.68	4.21	1.33	2.96	28.54
Average	74.11	6.52	9.67	2.98	11.06	36.04
Std	12.45	1.74	2.67	1.16	7.25	21.02

Annex III

Table 2: Correlation Coefficients for Nominal Prices, 1965-89

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 24

	COCOA	COFFEE	TEA	COTTON	TOBACCO	LOGS	COPPER	IRONORE	CRUDEOIL	INDEX33
COCOA	1.00000	0.92161	0.80796	0.80251	0.73166	0.61288	0.29553	0.71387	0.64582	0.84697
	0.0000	0.0001	0.0001	0.0001	0.0001	0.0015	0.1609	0.0001	0.0007	0.0001
COFFEE	0.92161	1.00000	0.80967	0.74083	0.78070	0.69343	0.28121	0.77812	0.67415	0.84939
	0.0001	0.0000	0.0001	0.0001	0.0001	0.0002	0.1831	0.0001	0.0003	0.0001
TEA	0.80796	0.80967	1.00000	0.73632	0.75323	0.65350	0.20138	0.72773	0.75844	0.78587
	0.0001	0.0001	0.0000	0.0001	0.0001	0.0005	0.3454	0.0001	0.0001	0.0001
COTTON	0.80251	0.74083	0.73632	1.00000	0.83881	0.75872	0.50213	0.87814	0.83740	0.92574
	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0124	0.0001	0.0001	0.0001
TOBACCO	0.73166	0.78070	0.75323	0.83881	1.00000	0.86809	0.45055	0.93125	0.94600	0.91710
	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0271	0.0001	0.0001	0.0001
LOGS	0.61288	0.69343	0.65350	0.75872	0.86809	1.00000	0.67476	0.83752	0.78309	0.87466
	0.0015	0.0002	0.0005	0.0001	0.0001	0.0000	0.0003	0.0001	0.0001	0.0001
COPPER	0.29553	0.28121	0.20138	0.50213	0.45055	0.67476	1.00000	0.50087	0.37738	0.62104
	0.1609	0.1831	0.3454	0.0124	0.0271	0.0003	0.0000	0.0127	0.0691	0.0012
IRONORE	0.71387	0.77812	0.72773	0.87814	0.93125	0.83752	0.50087	1.00000	0.89306	0.93054
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0127	0.0000	0.0001	0.0001
CRUDEOIL	0.64582	0.67415	0.75844	0.83740	0.94600	0.78309	0.37738	0.89306	1.00000	0.85202
	0.0007	0.0003	0.0001	0.0001	0.0001	0.0001	0.0691	0.0001	0.0000	0.0001
INDEX33	0.84697	0.84939	0.78587	0.92574	0.91710	0.87466	0.62104	0.93054	0.85202	1.00000
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0012	0.0001	0.0001	0.0000

Annex III

Table 3. Correlation Coefficients for Real Prices*, 1965-89

PEARSON CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 24

	COCOA	COFFEE	TEA	COTTON	TOBACCO	LOGS	COPPER	IRONORE	CRUDEOIL	INDEX33
COCOA	1.00000	0.74573	0.20972	0.28113	0.13319	-0.16773	0.03494	-0.00951	-0.04050	0.29157
	0.0000	0.0001	0.3253	0.1833	0.5350	0.4334	0.8712	0.9648	0.8510	0.1669
COFFEE	0.74573	1.00000	0.39410	0.25870	0.17169	-0.19422	0.10733	0.20854	-0.20221	0.33071
	0.0001	0.0000	0.0567	0.2222	0.4224	0.3631	0.6177	0.3281	0.3433	0.1145
TEA	0.20972	0.39410	1.00000	0.68141	0.82773	-0.06346	0.82288	0.89363	-0.65161	0.85945
	0.3253	0.0567	0.0000	0.0002	0.0001	0.7683	0.0001	0.0001	0.0006	0.0001
COTTON	0.28113	0.25870	0.68141	1.00000	0.68315	-0.13021	0.75813	0.77594	-0.63926	0.88354
	0.1833	0.2222	0.0002	0.0000	0.0002	0.5442	0.0001	0.0001	0.0008	0.0001
TOBACCO	0.13319	0.17169	0.82773	0.68315	1.00000	-0.03186	0.86460	0.86845	-0.67411	0.83737
	0.5350	0.4224	0.0001	0.0002	0.0000	0.8825	0.0001	0.0001	0.0003	0.0001
LOGS	-0.16773	-0.19422	-0.06346	-0.13021	-0.03186	1.00000	0.10985	-0.07623	-0.06315	-0.05679
	0.4334	0.3631	0.7683	0.5442	0.8825	0.0000	0.6094	0.7233	0.7694	0.7921
COPPER	0.03494	0.10733	0.82288	0.75813	0.86460	0.10985	1.00000	0.93219	-0.80026	0.93629
	0.8712	0.6177	0.0001	0.0001	0.0001	0.6094	0.0000	0.0001	0.0001	0.0001
IRONORE	-0.00951	0.20854	0.89363	0.77594	0.86845	-0.07623	0.93219	1.00000	-0.77466	0.91708
	0.9648	0.3281	0.0001	0.0001	0.0001	0.7233	0.0001	0.0000	0.0001	0.0001
CRUDEOIL	-0.04050	-0.20221	-0.65161	-0.63926	-0.67411	-0.06315	-0.80026	-0.77466	1.00000	-0.75907
	0.8510	0.3433	0.0006	0.0008	0.0003	0.7694	0.0001	0.0001	0.0000	0.0001
INDEX33	0.29157	0.33071	0.85945	0.88354	0.83737	-0.05679	0.93629	0.91708	-0.75907	1.00000
	0.1669	0.1145	0.0001	0.0001	0.0001	0.7921	0.0001	0.0001	0.0001	0.0000

* Prices deflated by the import price index for SSA.

REFERENCES

Balassa, Bela, "Policy Responses to Exogenous Shocks in Developing Countries," American Economic Proceedings 76, No. 2, May 1986, pp. 75-8.

Birati, A., J. Deutsch and M. Ungar, "Exchange Rate Risk and Efficient Debt Structures," Working Paper No. 8609, Department of Economics and Business Administration, The Economic Research Institute, Bar-Ilan University, 1986.

Claessens, Stijn, "Optimal Currency Composition of External Debt," PRE Working Paper 14, World Bank, June 1988

Claessens, Stijn, "Integrating Commodity and Exchange Risk: Implications for External Debt Management," in Priovolos, Theophilos and Ron Duncan, Commodity Risk Management and Finance, Oxford University Press, 1990.

Claessens, Stijn and Jonathan Coleman, "Financial Risk Management for Papua New Guinea," in progress, The World Bank, IEC.

Claessens, Stijn and Ken Kroner, "Optimal Currency Composition: Mexico and Brazil," in progress, The World Bank, IEC.

Coleman, Jonathan and Ying Qian, "The Optimal External Debt Structure: The Case of Papua New Guinea," May 1990, mimeo, The World Bank, IEC.

Cuddington, John, "Commodity Booms in Developing Countries," World Bank Research Observer, July 1989, Vol. 4, No. 2, pp. 143-65.

Culagovski, Jorge, et. al., "African Financing Needs in the 1990s," mimeo, presented at the conference, "African External Finance in the 1990s," September, 1990.

Dornbusch, Rudiger, "Exchange Rates and Prices, American Economic Review, 77, 1987, pp. 93-102.

Folkerts-Landau, David, "Marked-to-Market Swaps", in Jacob A. Frenkel, Michael P. Dooley and Peter Wickham, eds., Analytical Issues in Debt, Washington, D.C, International Monetary Fund, 1989, pp. 372-397

Gilbert, Christopher, "The Impact of Exchange Rates and Developing Country Debt on Commodity Prices," Economic Journal, 99, 1989, pp. 773-84.

Hansen, Lars Peter and Thomas J. Sargent, "Formulating and Estimating Dynamic Linear Rational Expectations Models," Journal of Economic Dynamics and Control, 2, 1980, pp. 7-46.

Kroner, Ken and Stijn Claessens, "Optimal Dynamic Hedging Portfolios and the Currency Composition of External Debt," forthcoming, Journal of International Money and Finance.

Masuoka, Toshiya, "Asset and Liability Management in Developing Countries: Modern Financial Techniques. A Primer," PRE Working Paper 454, World Bank, June 1990.

Myers, Robert J. and Stanley R. Thompson, "Optimal Portfolios of External Debt in Developing Countries: The Potential Role of Commodity-Linked Bonds," American Journal of Agricultural Economics, May 1989, pp. 517-22.

Newbery, David and Joseph Stiglitz, The Theory of Commodity Price Stabilization, Oxford University Press, Oxford, 1981.

Priovolos, Theophilos and Ron Duncan, Commodity Risk Management and Finance, Oxford University Press, 1990.

Quarterly Review of Financial Flows to Developing Countries, December 1989, World Bank, IECDI.

Watson, et al, International Capital Markets, April 1990, IMF, World Economic and Financial Survery.

Yeats, Alexander J., "Do African Countries Pay More for Imports? Yes," World Bank Economic Review, Vol. 4, No. 1, January 1990, pp. 1-20.

PRE Working Paper Series

	Title	Author	Date	Contact for paper
WPS568	Higher Wages for Relief Work Can Make Many of the Poor Worse Off: Recent Evidence from Maharashtra's "Employment Guarantee Scheme"	Martin Ravallion Gaurav Datt Shubham Chaudhuri	January 1991	C. Spooner 30464
WPS569	Domestic Purchase Requirements for Import License Allocations in Mali	Wendy E. Takacs	January 1991	S. Fallon 37947
WPS570	Debt Concentration and Secondary Market Prices	Raquel Fernandez Sule Ozler	January 1991	S. King-Watson 31047
WPS571	Credit's Effect on Productivity in Chinese Agriculture: A Microeconomic Model of Disequilibrium	Gershon Feder Lawrence J. Lau Justin Y. Lin Xiaopeng Luo	January 1991	C. Spooner 30464
WPS572	Capital Positions of Japanese Banks	Edward J. Kane Haluk Unal Asli Demirguc-Kunt	January 1991	S. King-Watson 33730
WPS573	Malaysian Labor Markets Under Structural Adjustment	Dipak Mazumdar	January 1991	M. Schreier 36432
WPS574	Public Policies and Saving in Developing Countries	Vittorio Corbo Klaus Schmidt-Hebbel	January 1991	S. Jonnakuty 39074
WPS575	Household Saving in Developing Countries: First Cross-Country Evidence	Klaus Schmidt-Hebbel Steven B. Webb Giancarlo Corsetti	January 1991	E. Khine 39361
WPS576	Lessons from Tax Reform: An Overview	Wayne Thirsk	January 1991	A. Bhalla 37699
WPS577	Africa's Rising Inflation: Causes, Consequences, and Cures	Ajay Chhibber	February 1991	B. Dhomun 39413
WPS578	The Bank's Use of Technical Assistance for Institutional Development	Beatrice Buyck	January 1991	E. Madrona 37496
WPS579	Chile's Experience with Stabilization Revisited	Vittorio Corbo Andrés Solimano	January 1991	E. Khine 39361
WPS580	Do Natural Resource-Based Industrialization Strategies Convey Important (Unrecognized) Price Benefits for Commodity-Exporting Developing Countries?	Alexander J. Yeats	January 1991	J. Jacobson 33710

PRE Working Paper Series

	Title	Author	Date	Contact for paper
WPS581	How Successful is World Bank Lending for Structural Adjustment?	Patrick Conway	January 1991	S. Fallon 37947
WPS582	Adjustment Programs and Bank Support: Rationale and Main Results	Vittorio Corbo Stanley Fischer	January 1991	L. Oropesa 39075
WPS583	World Bank Lending for Education Research, 1982-89	Marlaine E. Lockheed Alastair G. Rodd	January 1991	C. Cristobal 33640
WPS584	Whither Hungary and the European Communities?	Alfred Tovias Sam Laird	January 1991	G. Ilogon 33732
WPS585	Financial Innovation and Money Demand: Theory and Empirical Implementation	Patricio Arrau Jose de Gregorio	January 1991	S. King-Watson 31047
WPS586	The Challenging Arithmetic of Poverty in Bangladesh	Martin Ravallion	February 1991	WDR Office 31393
WPS587	Quantifying the Magnitude and Severity of Absolute Poverty in the Developing World in the Mid-1980s	Martin Ravallion Gaurav Datt Dominique van de Walle Elaine Chan	February 1991	WDR Office 31393
WPS588	Obstacles to Developing Small and Medium-Sized Enterprises: An Empirical Assessment	Brian Levy	February 1991	E. Madrona 37496
WPS589	To Prescribe or Not to Prescribe: On the Regulation of Pharmaceuticals in Developing Countries	Jeffrey S. Hammer	February 1991	O. Nadora ~~S6-065~~
WPS590	The Domestic Financial Market and the Trade Liberalization Outcome: The Evidence from Sri Lanka	Premachandra Athukorala Sarath Rajapatirana	February 1991	M. Kienzle 30733
WPS591	Global Indicators of Nutritional Risk	Rae Galloway	February 1991	O. Nadora 31091
WPS592	Official Credits to Developing Countries: Implicit Transfers to the Banks	Asli Demirgüç-Kunt Harry Huizinga	February 1991	S. King-Watson 33730
WPS593	Risk Management in Sub-Saharan Africa	Stijn Claessens Ying Qian	February 1991	J. Carroll 33715